California Advanced Reciprocating Internal Combustion Engines Collaborative Workshop

Employment Development Department Auditorium

722 Capitol Mall

Sacramento, CA

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California Advanced Reciprocating Internal Combustion Engines (ARICE) Collaborative - Purpose, Mission, Goals, and Targets, and Action Plan

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California Energy Commission (CEC)

Purpose

The purpose of the California Advanced Reciprocating Internal Combustion Engines Collaborative is to take a leadership role in facilitating the research and development (R&D) of advanced reciprocating internal combustion engine (ARICE) systems that are super-efficient and ultra-clean for distributed, mobile, emergency and other power generation and stationary applications throughout California.

Mission Statement

The mission of the California Advanced Reciprocating Internal Combustion Engines Collaborative is to promote research and development of ARICE components and systems as a means toward reducing or eliminating criteria air pollutants and greenhouse gas emissions, increasing energy efficiency, promoting energy diversity and independence, promoting clean fuels for ARICE applications, and realizing a sustainable energy future in California

Key Goals

- Facilitate the research, development, demonstration, and commercialization of ARICE technologies by funding projects in partnership with stakeholders;
- Facilitate the development of emission tests protocols that would establish common testing and evaluation criteria applicable to various parameters, such as alternative fuel, engine modification, add-on components, or combination of parameters.
- Implement an independent and continuing inter-departmental policy in California to utilize efficient and clean ARICE distributed power generation technologies in distributed generation, emergency power, and other stationary applications (e.g. coordination with ARB's Distributed Generation activities); and
- Work with utilities and regulators to adopt policies that encourage the use of ARICE systems for power generation where size and suitability are compatible.

Industry Issues and Concerns

The general activities include:

- high efficiency,
- environmental concerns/emissions,
- fuel flexibility,
- operating and maintenance (O&M) cost,
- availability, reliability and maintainability

Proposed Projects for R&D of ARICE systems should do one or more of the following:

- lower or maintain current capital cost, installation cost, operation and maintenance cost, and/or life cycle costs; (Note: The installation cost is very site dependent. The life cycle cost would capture the capital and O&M costs.)
- improve fuel-to-electricity conversion efficiency;
- increase the overall energy use efficiency through combined heat and power systems;
- meet or exceed current and future California atmospheric emissions requirements and have other desirable environmental attributes;
- enhance reliability, availability, maintainability, durability, and usability;
- promote development of clean (alternative, renewable, and distillate) fuels;
- have multi-fuel use capabilities;
- support integration and aggregation of distributed (both Mobile and Stationary) generation and on-site generation with the power grid;
- in general, lead to the adoption and use of the improved ARICE technologies within California.

Commitments

- Public: R&D Funds, Policies, Benefits
- Private: R&D Resources and Match Funds, Priorities & Targets

The potential public benefits will need to be clear and significant for the public sector's sustained interest in supporting an ARICE R&D program for California

Short-Term (Less than 1 year) Tasks:

Short Term Task	Completion Date
Collaborative Plan	May, 2001
Identify and confirm Core Group	May 31, 2001
Identify and confirm Advisory Group	May 29 – June 8, 2001
Workshop Invitations	June 1, 2001
Summer Workshop with Industry	June 10, 2001
RFP/Solicitation	September 2001
Contracts Accepted	December 15, 2001
Contracts Awarded	January 31, 2002

Current Diesel and Natural Gas Engines Data[1]

	Electric Efficiency (LHV)	Size (MW)	Footprint (sqft/kW)	Installed cost ($/kW)	O&M Cost ($/kWh)	Availability	Hours between overhauls	Start-up Time	NOx emissions (lb/MW-hr)	CHP output (Btu/kWh)
Diesel Engine	30-50%	0.05-5	0.22	800-1500	0.005-0.008	90-95%	25,000-30,000	10 sec	3-33	3,400
Natural Gas Engine	24-45%	0.05-5	0.22-0.31	800-1500	0.007-0.015	92-97%	High Speed: 24,000-60,000 Medium Speed: 60,000-80,000	30 sec	2.2-2.8	1,000-5,000

[1] *The market and Technical Potential for Combined Heat and Power in the Commercial/Institutional Sector.* ONSITE SYCOM Energy Corporation, prepared for Energy Information Administration (EIA). U.S. DOE, January 2000 (Revision 1), Washington, D.C.

US DOE Distributed Energy Resources (DER)

Their program has set goals to achieve 20% plus of new electricity additions by 2010 with a suite of distributed energy technologies that will have increased efficiency and reliability with reduced costs and emissions.[2] U.S. electricity generation is expected to increase by 30% through year 2020.[3] Natural gas ARES systems are expected to increase efficiencies to >50% and decrease emissions to <0.1 g/bhp-hr (≈0.3 lb/MW-hr) NOx by 2010.

Performance Targets and Stretch Goals for ARICE Systems Solicitation

Parameter	Target	Stretch Goal
Fuel to Electricity Efficiency Overall Energy Efficiency	>50% >80%	55% >85%
Emissions (g/bhp-hr)		
NOx	<0.1	<0.05
VHC	<???	<???
CO	<???	<???
PM10	<0.1	<0.05
Availability	80%	95%
Reliability		
Complete Installed Cost ($/kW)	<700	600
Mean Time Between Overhaul		
O&M Cost		
Durability (hours)	8,000	10,000
Performance Degradation		
Multi-Fuel Capability		